

PROTECTION PRODUCTS
Absolute Maximum Rating

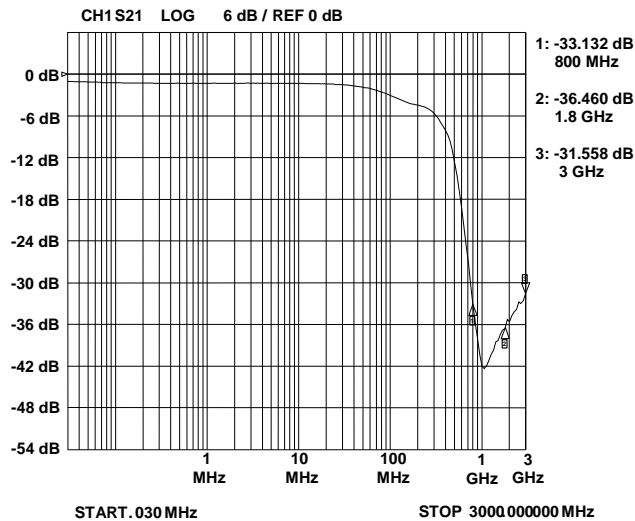
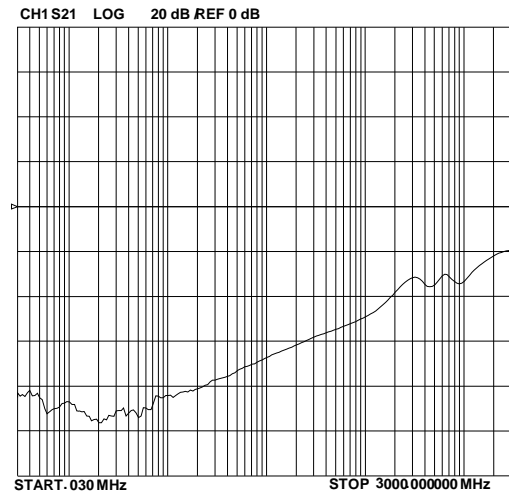
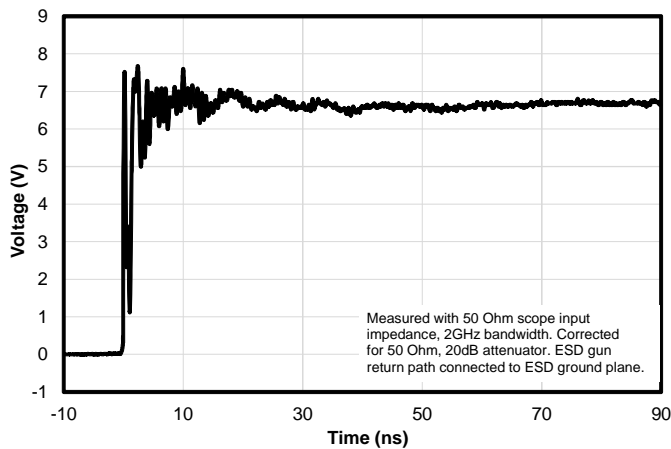
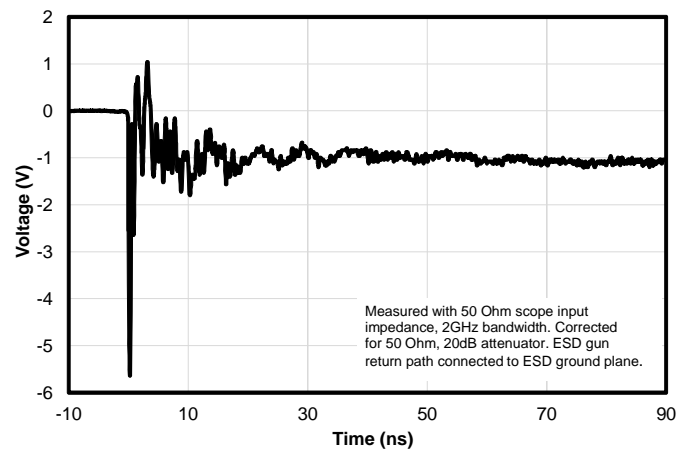
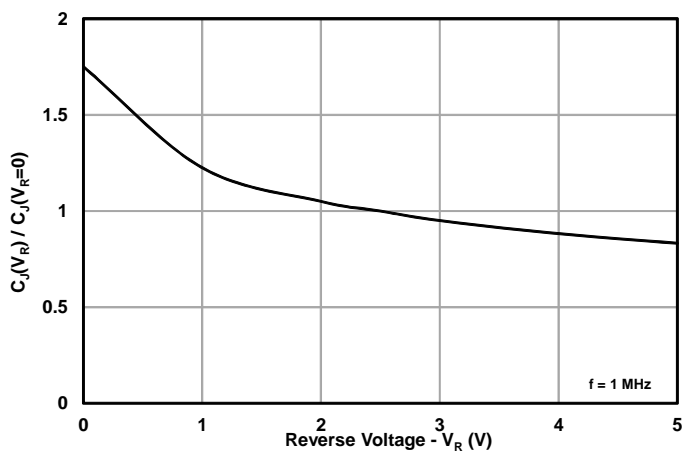
Rating	Symbol	Value	Units
ESD per IEC 61000-4-2 (Air) ¹ ESD per IEC 61000-4-2 (Contact) ¹	V_{ESD}	+/- 20 +/- 15	kV
Junction Temperature	T_J	125	°C
Operating Temperature	T_{op}	-40 to +85	°C
Storage Temperature	T_{STG}	-55 to +150	°C

Notes

1) Measured with a 20dB attenuator, 50 Ohm scope input impedance, 2GHz bandwidth. ESD gun return path connected to ESD ground plane.

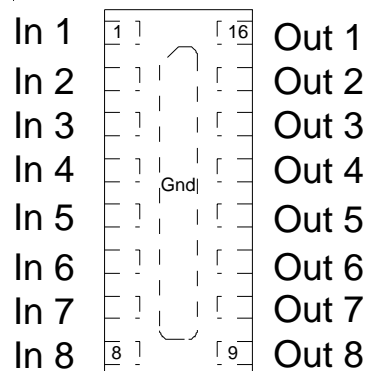
Electrical Characteristics (T=25°C)

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units
Reverse Stand-Off Voltage	V_{RWM}	Any I/O to GND			5	V
Reverse Breakdown Voltage	V_{BR}	$I_L = 1mA$, Any I/O to GND	6	8	10	V
Reverse Leakage Current	I_R	$V_{RWM} = 5.0V$, Any I/O to GND			0.100	μA
DC Resistance	R_{DC}	Each Channel, Between Input and Output		18		Ohms
Filter Cut-Off Frequency	f_c	$Z_{Source} = Z_{Load} = 50 \text{ Ohms}$		150		MHz
Inductance	L			19		nH
Total Series Inductance	$L_1 + L_2$	Each Channel, Between Input and Output		38		nH
Capacitance	C_1, C_2, C_3	$V_R = 2.5V, f = 1MHz$	10	12	15	pF
Total Capacitance	$C_1 + C_2 + C_3$	$V_R = 2.5V, f = 1MHz$, Each Channel Input to GND	30	36	45	pF

PROTECTION PRODUCTS
Typical Characteristics
Typical Insertion Loss S21 (Each Line)

Analog Crosstalk (Each Line)

**ESD Clamping (+8kV Contact per IEC 61000-4-2)
Each Channel to GND**

**ESD Clamping (-8kV Contact per IEC 61000-4-2)
Each Channel to GND**

**Capacitance vs. Reverse Voltage
(Normalized to 2.5 volts)**


PROTECTION PRODUCTS
Applications Information
Device Connection

The EClamp2398P is comprised of eight identical circuits each consisting of a low pass filter for EMI/RFI suppression and dual TVS diodes for ESD protection. The device is in a 16-pin SLP package. Electrical connection is made to the 16 pins located at the bottom of the device. A center tab serves as the ground connection. The device has a flow through design for easy layout. Pin connections are noted in Figure 1. All path lengths should be kept as short as possible to minimize the effects of parasitic inductance in the board traces. Recommendations for the ground connection are given below.

Figure 1 - Pin Identification and Configuration (Top Side View)

Ground Connection Recommendation

Parasitic inductance present in the board layout will affect the filtering performance of the device. As frequency increases, the effect of the inductance becomes more dominant. This effect is given by Equation 1.

Equation 1: The Impedance of an Inductor at Frequency XLF

$$XLF(L,f) = 2 * \pi * f * L$$

Where:

L= Inductance (H)

f = Frequency (Hz)

Via connections to the ground plane form rectangular wire loops or ground loop inductance as shown in Figure 2. Ground loop inductance can be reduced by using multiple vias to make the connection to the ground plane. Bringing the ground plane closer to the signal layer (preferably the next layer) also reduces ground loop inductance. Multiple vias in the device ground pad will result in a lower inductive ground loop over two exterior vias. Vias with a diameter d are separated by a distance y run between layers separated by a distance x. The inductance of the loop path is given by Equation 2. Thus, decreasing distance x and y will reduce the loop inductance and result in better high frequency filter characteristics.

Pin	Identification
1 - 8	Input Lines
9 - 16	Output Lines
Center Tab	Ground

Figure 2 - Inductance of Rectangular Wire Loops
Equation 2: Inductance of Rectangular Wire Loop

$$L_{RECT}(d, x, y) = 10.16 * 10^{-9} * \left[x * \ln \left[\frac{2 * y}{d} \right] + y * \ln \left[\frac{2 * x}{d} \right] \right]$$

Where:

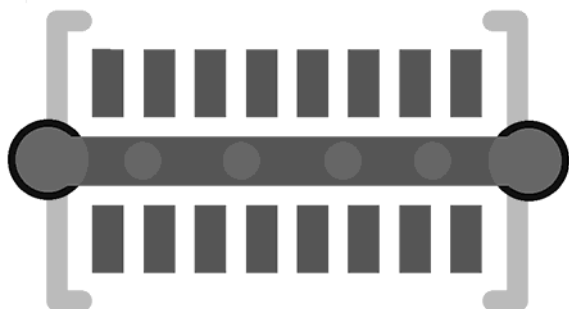
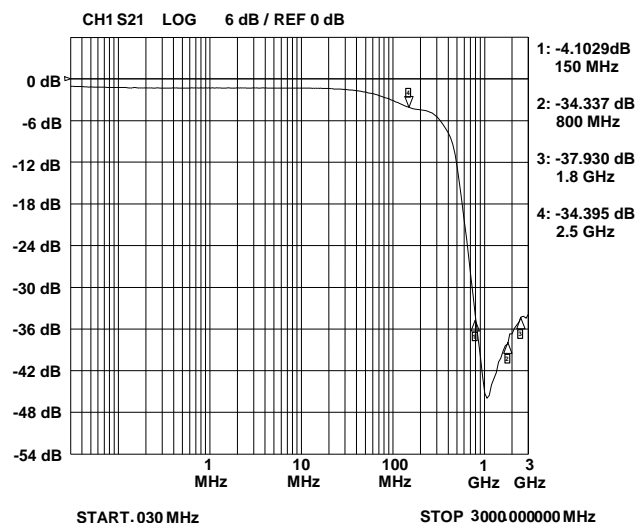
d = Diameter of the wire (in)

x = Length of wire loop (in)

y = Breath of wire loop (in)

PROTECTION PRODUCTS
Applications Information

Figure 3 shows the recommended device layout. The ground pad vias have a diameter of 0.008 inches (0.20 mm) while the two external vias have a diameter of 0.010 inches (0.250mm). The internal vias are spaced approximately evenly from the center of the pad. The designer may choose to use more vias with a smaller diameter (such as 0.005 inches or 0.125mm) since changing the diameter of the via will result in little change in inductance (i.e. the log function in Equation 2 is highly insensitive to parameter d) . Figure 4 shows a typical insertion loss (S21) plot for the device using Semtech's filter evaluation board with 50 Ohm traces and the recommended via configuration.

Figure 3 - Recommended Layout Using Ground Vias

Figure 4 - Filter Characteristics Using Recommended Layout with Internal Vias


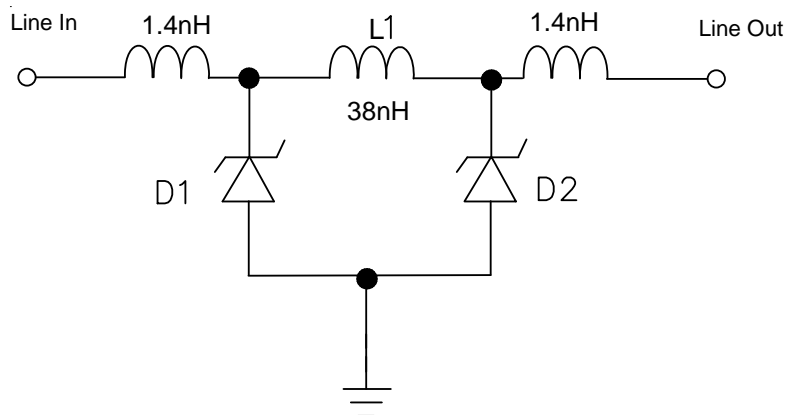
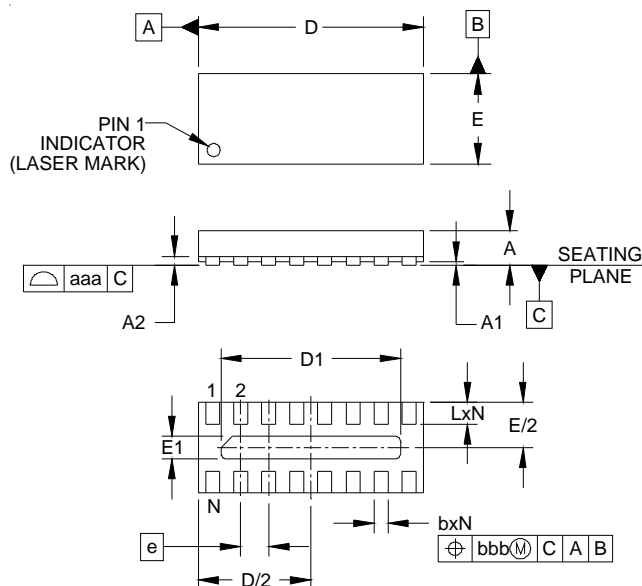


Figure 1 - EClamp2398P Spice Model

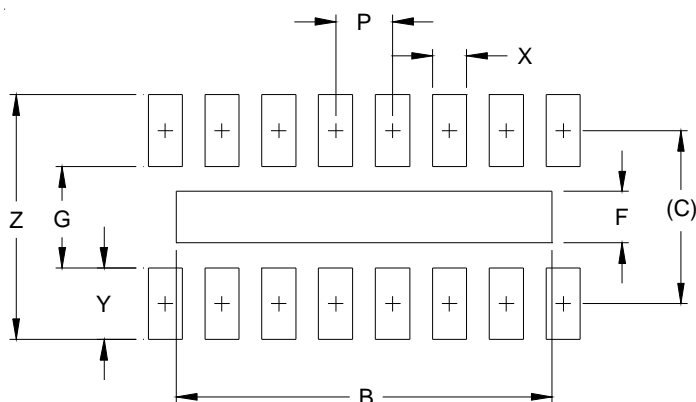
Table 1 - EClamp2398P Spice Parameters			
Parameter	Unit	D1 (TVS)	D2 (TVS)
IS	Amp	4.09E-15	4.09E-15
BV	Volt	7.435	7.435
VJ	Volt	0.743	0.743
RS	Ohm	0.584	0.584
IBV	Amp	1E-3	1E-3
CJO	Farad	31.3E-12	31.3E-12
TT	sec	2.541E-9	2.541E-9
M	--	0.23	0.23
N	--	1.1	1.1
EG	eV	1.11	1.11

PROTECTION PRODUCTS
Outline Drawing - SLP4014P16


DIM	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	.020	.023	.026	0.50	0.58	0.65
A1	.000	.001	.002	0.00	.003	0.05
A2		(.005)			(0.13)	
b	.007	.010	.012	0.20	0.25	0.30
D	.153	.157	.161	3.90	4.00	4.10
D1	.122	.126	.130	3.10	3.20	3.30
E	.059	.063	.067	1.50	1.60	1.70
E1	.010	.016	.020	0.25	0.40	0.50
e		.020 BSC			0.50 BSC	
L	.011	.013	.015	0.28	0.33	0.38
N		16			16	
aaa		.003			0.08	
bbb		.004			0.10	

NOTES:

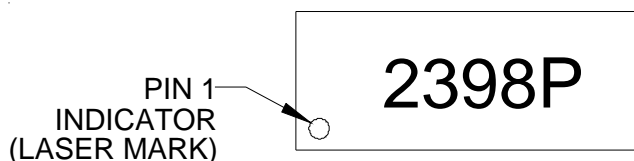
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

Land Pattern - SLP4014P16


DIM	DIMENSIONS	
	INCHES	MILLIMETERS
B	.130	3.30
C	.060	1.52
F	.018	0.45
G	.035	0.89
P	.020	0.50
X	.012	0.30
Y	.025	0.63
Z	.085	2.15

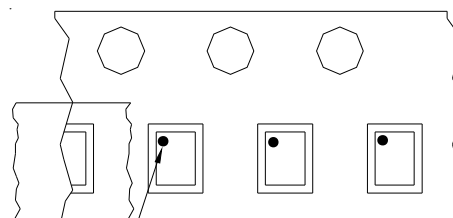
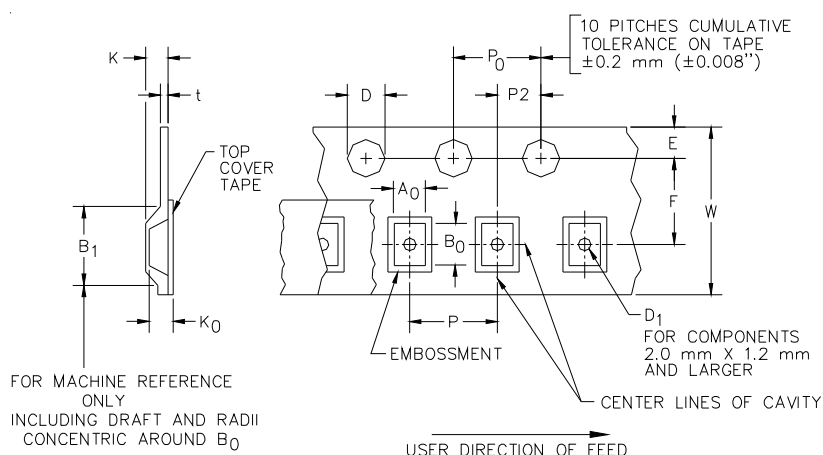
NOTES:

1. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY.
CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR
COMPANY'S MANUFACTURING GUIDELINES ARE MET.

PROTECTION PRODUCTS
Marking Codes

Ordering Information

Part Number	Qty per Reel	Reel Size
EClamp2398P.TCT	3000	7 Inch

EMIClamp and EClamp are trademarks of Semtech Corporation.

Carrier Tape Specification


Pin 1 Location

→
User Direction of feed

Device Orientation in Tape

A0	B0	K0
1.78 +/-0.10 mm	4.30 +/-0.10 mm	0.74 +/-0.10 mm

Tape Width	B, (Max)	D	D1	E	F	K (MAX)	P	P0	P2	T(MAX)	W
12 mm	8.2 mm (.476)	1.5 + 0.1 mm - 0.0 mm (0.59 +.005 - .000)	1.0 mm ±0.05 (.039)	1.750±.10 mm (.069±.004)	5.5±0.05 mm (.217±.002)	4.5 mm (.177)	4.0±0.1 mm (.157±.00- 4)	4.0±0.1 mm (.157±.00- 4)	2.0±0.05m- m (.079±.002)	0.4 mm (.016)	12.0 mm + 0.3 mm - 0.1 mm (.472±.012)

Contact Information

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